DETAILED ACTION

Drawings

1. Figure 6 is objected to because it fails to show text labels of the figure blocks. Text labels, in addition to numerical reference characters, allow for quicker searching and examining.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

3. The abstract of the disclosure is objected to because it contains legal phraseology. Correction is required. See MPEP § 608.01(b).

4. The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) TITLE OF THE INVENTION.
(b) CROSS-REFERENCE TO RELATED APPLICATIONS.
(c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
(d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
(e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
(f) BACKGROUND OF THE INVENTION.
    (1) Field of the Invention.
    (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(g) BRIEF SUMMARY OF THE INVENTION.
(h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
(i) DETAILED DESCRIPTION OF THE INVENTION.
(j) CLAIM OR CLAIMS (commencing on a separate sheet).

(k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
(l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

5. The specification is object to for failing to include section headings. Appropriate correction is required.

Claim Objections

6. Claims 1-10 and 23 are objected to because of the following informalities:

- Step (v) is incorrectly labeled as step (iv).
- Line 5 of claim 1 should read: "...signals, using a weighting apparatus."

Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claim 2 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claim 2 is written, "The method of claim 1 including selecting signals with highest input power to be nulled during at least one of step (i) and step (iii)." However, lines 25-27 of page 4 of the specification do not support this. The specification says signals with the *lowest* input power are selected to be nulled.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1-10 and 23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The word "substantially" in line 4 of claim 1 renders the claim indefinite since it is unclear to what degree "a number of said signals" are nulled. "Substantial" is defined as "being largely but not wholly that which is specified." "Substantial" is also defined as, "considerable in quantity," which may be interpreted as, "completely." It is unclear which definition of "substantial" applies to the claim.

For the purposes of this examination, the examiner has interpreted "substantially" to mean "completely."

The limitation, "reducing the number of signals nulled by the weighting apparatus by at least a number of non-nulled signals in step (ii)," recited in lines 10-11 of claim 1, renders the claim indefinite because it is not explicitly clear what "at least a number of" means.

For the purposes of this examination, the examiner has interpreted "at least a number of" to mean "one."

11. Claim 1 recites the limitation "determining a symbol or codeword associated with at least one said non-nulled signal..." in lines 6-8. There is insufficient antecedent basis for this limitation in the claim. "Non-nulled signal" is not defined anywhere previously in the claim.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 1, 3-24, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al. (US 2001/0053143 A1) in view of Shattil (US 2004/0012387 A1).

Regarding claim 1:

As shown in figure 4, Li discloses a method of determining each of a plurality of data symbols or codewords from a plurality of signals comprising the steps of:

- (i) weighting a number of said signals so as to substantially treating as interference said number of signals, using weighting apparatus (**see ¶ [0039]**);
- (ii) determining a symbol or codeword associated with at least one non-treated as interference signal using a processor arranged to execute a maximum likelihood estimation process upon said at least one non-treated as interference signal (**see ¶ [0041]**);
- (iii) reducing the number of signals treated as interference by the weighting apparatus by at least a number of non-treated as interference signals in step (ii) (**see ¶ [0038]**);

- (iv) altering a maximum likelihood metric in accordance with the data symbol derived at step (ii) (**see ¶ [0049]**); and

- (v) repeating steps (ii) to (iv) (**see ¶ [0038]**).

Rather than using weights to null at least one signal to prevent the at least one signal from participating in the altering of a maximum likelihood metric, Li discloses treating said signal as interference.

However, Shattil discloses using weights to cancel, i.e. null signals (**see ¶ [0012] - [0013]**).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the invention of Li as taught by Shattil and use the weights of the weighting apparatus to null said number of signals rather than treat said number of signals as interference, thus allowing the cancellation of undesired signals, which allows for more efficient demodulation (**Shattil, ¶ [0003]**).

Regarding claim 3:

The combination of Li and Shattil discloses the method of claim 1 including separating frequencies of at least some of the plurality of signals by multiples of a harmonic frequency (**see Li, figure 4, reference characters IFFT1-4**).

Regarding claim 4:

The combination of Li and Shattil discloses the method of claim 1 including orthogonalising each of the plurality of signals **(see Li, figure 4, reference characters IFFT1-4)**.

Regarding claim 5:

The combination of Li and Shattil discloses the method of claim 1 including transmitting the plurality of signals at a range of frequencies from a plurality of spatially separated transmitters **(see Li, figure 4, reference characters TA1-4)**.

Regarding claim 6:

The combination of Li and Shattil discloses the method of claim 1 including providing a plurality of receivers arranged to receive said plurality of signals prior to step (i) **(see Li, figure 4, reference characters RA1-P)**.

Regarding claim 7:

The combination of Li and Shattil discloses the method of claim 1 including determining symbols that form at least part of, codewords, the codewords being associated with streams of symbols input to a transmitter **(see Li, ¶ [0024])**.

Regarding claim 8:

The combination of Li and Shattil discloses the method of claim 1 including deriving a matrix of complex weighting co-efficients by the processor to be applied to said weighting apparatus in order to null said signals at one of step (i) and step (iii) **(see Shattil, ¶ [0066])**.

Regarding claim 9:

The combination of Li and Shattil discloses the method of claim 1 including sampling channel state information data to determine which signals are to be nulled during at least one of step (i) and step (iii) **(see Li, ¶ [0030])**.

Regarding claim 10:

The combination of Li and Shattil discloses the method of claim 1 including using the vector Viterbi algorithm at step (ii) **(see Li, ¶ [0049])**.

Regarding claim 11:

As shown in figure 4, Li discloses a signal receiving apparatus comprising

- a plurality of receiving elements **(see figure 4, reference characters RA1-RAP)**,
- weighting apparatus **(see figure 4, reference character STP)**, and
- a decoder **(see figure 4, reference characters STD1 and STD2)**,
- each of the receiving elements having respective weighting apparatus associated therewith **(see ¶ [0025]-¶ [0030] where Li describes the space-time processor treating each receiving element individually)**,
- each of the receiving elements being arranged to receive a plurality of signals transmitted from a plurality of transmitters **(see figure 4, reference characters TA1-TA4)**,
- the weighting apparatus means being arranged to apply a function to each of a number of said signals received by the receiving elements in order to treat as interference said number of said signals **(see ¶ [0052])**,

- the decoder being arranged to determine a symbol or codeword associated with a non-treated as interference signal and to incorporate said symbol or codeword in the determination of at least one further symbol or codeword (**see ¶ [0055]**).

Li does not specifically disclose applying a complex weighting function to each of a number of said signals received by the receiving elements at a given frequency in order to null said number of said signals. Rather than nulling, Li treats said signals as interference.

However, Shattil discloses applying a complex weighting function to each of a number of signals received by the receiving elements at a given frequency in order to null said number of signals (**see ¶ [0013]-¶ [0016]**).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the invention of Li as taught by Shattil and apply a complex weighting function to each of a number of signals received by the receiving elements at a given frequency in order to null said number of signals, thus allowing cancellation of undesired signals (**Shattil, ¶ [0003]**).

Regarding claim 12:

The combination of Li and Shattil discloses apparatus according to claim 11 including at least four receiving elements (**see Li, figure 4, reference characters RA1-P**).

Regarding claim 13:

The combination of Li and Shattil discloses apparatus according to claim 11 wherein each receiving element has a channel state information (CSI) unit arranged to compensate for distortion to the signal received by the apparatus due to variations in the transmission path of said signal associated therewith (**see Li, figure 4, reference character CPE**).

Regarding claim 14:

The combination of Li and Shattil discloses apparatus according to claim 11 including an FFT unit arranged to separate each of a plurality of sub-carrier signals from said received signals between each receiving element and the decoder (**see Li, figure 4, reference characters FFT1-P**).

Regarding claim 15:

The combination of Li and Shattil discloses apparatus according to claim 11 wherein the decoder includes a processor arranged to carry out a maximum likelihood estimation procedure upon a sub-carrier signal received at a receiving element in order to determine the symbol or codeword (**see Li, figure 4, reference characters STD1 and STD2**).

Regarding claim 16:

The combination of Li and Shattil discloses apparatus according to claim 15 wherein the processor is arranged to carry out whole vector Viterbi decoding upon the signal (**see Li, ¶ [0049]**).

Regarding claim 17:

The combination of Li and Shattil discloses apparatus according to claim 11 wherein the apparatus is arranged to execute a method of determining each of a plurality of data symbols or codewords from a plurality of signals, said method comprising the steps of:

- (i) weighting a number of said signals so as to substantially treating as interference said number of signals, using weighting apparatus (**see ¶ [0039]**);
- (ii) determining a symbol or codeword associated with at least one non-treated as interference signal using a processor arranged to execute a maximum likelihood estimation process upon said at least one non-treated as interference signal (**see ¶ [0041]**);
- (iii) reducing the number of signals treated as interference by the weighting apparatus by at least a number of non-treated as interference signals in step (ii) (**see ¶ [0038]**);
- (iv) altering a maximum likelihood metric in accordance with the data symbol derived at step (ii) (**see ¶ [0049]**); and
- (v) repeating steps (ii) to (iv) (**see ¶ [0038]**).

Li does not specifically disclose using weights to null signals.

However, Shattil discloses using weights to cancel, i.e. null signals (**see ¶ [0013]**).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the invention of Li as taught by Shattil and use the weights of the weighting apparatus of to null said number of signals, thus allowing cancellation of undesired signals (**Shattil, ¶ [0003]**).

Regarding claim 18:

As shown in figure 4, Li discloses a method of increasing data transfer capacity across a network comprising the steps of:

- (i) receiving a signal comprising a plurality of data carrying sub-channels at a plurality of receiving elements (**see figure 4, reference characters RA1-RAP ¶ [0023] where Li discusses a MIMO-OFDM system**);
- (ii) treating as interference a component of the signal associated with a given sub-channel received at all but one receiving element (**see ¶ [0039]**);
- (iii) determining a symbol or codeword associated with said signal received on said given sub-channel at said one receiving element using a maximum likelihood estimation process (**see ¶ [0041]**); and
- (iv) incorporating the symbol or codeword into the maximum likelihood estimation process for the determination of at least one other symbol or codeword (**see ¶ [0049]**).

Li does not specifically disclose using weights to null signals.

However, Shattil discloses using weights to cancel, i.e. null signals (**see ¶ [0013]**).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the invention of Li as taught by Shattil and use the weights of the weighting apparatus of to null said number of signals, thus allowing cancellation of undesired signals (**Shattil, ¶ [0003]**).

Regarding claim 19:

The combination of Li and Shattil discloses the method of claim 18 including parallelising data and encoding the data as a symbol or a space time codeword prior to transmission of the symbol or codeword over the network (**see Li, figure 1, reference character 20**).

Regarding claim 20:

The combination of Li and Shattil discloses the method of claim 18 including providing more than four receiving elements arranged to receive the signal from the network (**see Li, figure 4, reference characters RA1-P**).

Regarding claim 21:

The combination of Li and Shattil discloses the method of claim 18 including applying a whole vector Viterbi decoding to the signal at step (iii) (**see Li, ¶ [0049]**).

Regarding claim 22:

The combination of Li and Shattil discloses the method of claim 18 wherein the network is in the form of a wireless local area network or a mobile telecommunications network (**see Shattil, ¶ [0017]**).

Regarding claim 23:

The combination of Li and Shattil discloses a computer readable medium having stored therein instructions for causing a device to execute the method according to claim 1 (**see claim 1 since Li and Shattil disclose the method of claim 1, Li and Shattil also disclose the computer readable medium having stored therein instructions for causing a device to execute the method according to claim1**).

Regarding claim 24:

The combination of Li and Shattil discloses a program storage device readable by a machine and encoding a program of instructions which when operated upon the machine cause the machine to operate as the apparatus according to claim 11 (**see claim 11 since Li and Shattil disclose the apparatus according to claim 11, Li and Shattil also disclose a program storage device readable by a machine and encoding a program of instruction which when operated upon the machine cause the machine to operate as the apparatus according to claim 11**).

Regarding claim 28:

The combination of Li and Shattil discloses a computer readable medium having stored therein instructions for causing a device to execute the method according to claim 18 (**see claim 18 since Li and Shattil disclose the method according to claim 18, Li and Shattil also disclose a computer readable medium having stored therein instructions for causing a device to execute the method according to claim 18**).

14. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over over Li et al. (US 2001/0053143 A1) in view of Shattil (US 2004/0012387 A1) as applied to claim 1 above, and further in view of Won (US 2003/0076891 A1).

Regarding claim 2:

For the purposes of this examination, the examiner has interpreted claim 2 as: The method of claim 1 including selecting signals with ~~highest~~ lowest input power to be nulled during at least one of step (i) and step (iii).

The combination of Li and Shattil discloses the method of claim 1, including selecting signals to be nulled during at least one of step (i) and step (iii), however, the combination of Li and Shattil does not specifically disclose selecting signals with the lowest input power to be nulled.

Won discloses including selecting signals with lowest input power to be nulled (**see ¶ [0021] also, Won discloses V-BLAST which one of ordinary skill in the art would know includes decoding higher input power signals first**).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to modify the invention of Li and Shattil as taught by Won and select signal with the lowest input power to be nulled during at least one of step (i) and step (iii), thus allowing a simplified receiving circuit (**Won, ¶ [0022]**).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GINA MCKIE whose telephone number is (571)270-5148. The examiner can normally be reached on Mon-Fri, 9:00 AM-4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shuwang Liu can be reached on 571-272-3036. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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